International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 7 Issue 3, May-June 2023 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Development of Flat Lima Beans Pickles Enriched with Spirulina

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ABSTRACT

The product is different from the regular way of availability and to choose acceptable level of ingredients is important as more amount can cause unacceptable taste, texture and aroma of the product and hence standardization of the product is necessary. The creation of the product emphasis on the nutritional health of the consumer, ingredients used for this product has many health benefits hence standardization of the product is necessary. This literature focuses on many idea of new product development. Flat lima beans are consumed by many people but the product prepared in this study is not much available in the market, the product is enriched by spirulina due to its abundance health benefits. The information or studies available regarding methodology are limited for this product. Benefits of prebiotics include improvement in gut barrier function and also improving host immunity, reduction of potentially pathogenic bacteria (e.g., Clostridia) and consumer will come across with these benefits due to product created in this study. People also deficient in Vitamin B1 will also meet the nutritional benefits as flat lima beans are good source of Vitamin B1. This study will be helpful to gain perception of new product development, the market for the new product and the demand of consumers regarding nutritious and convenient food product. Product is nutritious as the aim is to provide health benefits. Product development includes all phases of creating a product, from the initial Product development includes all phases of creating a product, from the initial connected with the formulation of a new product on the market or the modification and presentation of an existing product on the market. The focus of the product development is therefore on the processes in the entire life cycle of a product, be it an idea, an innovation or consumption.

How to cite this paper: Raksha Dinesh Gupta | Roonal Kataria "Development of Flat Lima Beans Pickles Enriched with Spirulina" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-7 | Issue-3, June 2023, pp.335-340, URL: www.ijtsrd.com/papers/ijtsrd56361.pdf

IJTSRD56361

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KEYWORDS: *Spirulina, Flat lima beans, protein, nutrition*

1. INTRODUCTION

The scientific name of flat lima beans is Phaseolus Lunatus L, carbohydrate is the main component of lima bean seeds and accounts for about 53-71% of dry matter. Starch is the most abundant carbohydrate in legumes. The starch content of lima beans is typically around 200- 670 g kg-1 on a dry matter basis. Lima beans also contain approximately 35.0 g kg-1 TS of resistant starch. Lima beans have antioxidant properties, many phytochemical compounds present in lima beans have been reported to have antioxidant properties such as bioactive peptides. Along with being nutritionally very rich flat lima beans are also a good source of proteins and essential amino acids. They are rich in bioactive compounds that are beneficial tohealth. It may be useful to develop foods and dietary supplements/ nutraceuticals to increase lima bean consumption. (Bonita, Shantibala Devi, Singh, 2020, p. 5638)

Spirulina is blue-green algae that belong to cyanobacteria which is a protein rich source (46-63%), essential fatty acids, vitamins, and minerals. Spirulina is absolutely safe and can be usedto prepare functional foods. (Hussein,met al., 2021, p. 14736).

India is a country rich in horticulture, producing a wide variety of fruits, vegetables, spices, ornamentals and medicinal plants. It is the second largest vegetable producer in the world. Unfortunately, huge post-harvest losses occur (10-25%) annually. The main reason is due to ineffective post-harvest management.

Increasing production and productivity is not enough to achieve the goal of feeding a growing population and meeting the needs of the processing industry and export trade. As such, reducing post-harvest losses is an option to complete the food needs of the country as well as the economy.(Handbook of handmade pickles, PM Formalization of Micro Food Processing Enterprises (PM-FME) Scheme, Indian Institute of Food Processing Technology, Ministry of Food Processing Industries, Government of India,2018, p. 3) There are two main methods to reduce post-harvest losses of vegetables.

1. Scientific management of post-harvest vegetables.
2. Reducing losses through converting vegetables into various value-added products.

The firstapproach can be achieved by: Proper variety selection, proper harvesting, product sorting, washing, pruning, drying, waxing, pre-cooling, packaging and storage. The second case can be achieved through the processing of value-added products. Variety of value added product canbe made from fresh vegetables such as jam, chili sauce, ketchup, paste, pickles, dried vegetables, etc.(Handbook of handmade pickles, PM Formalization of Micro Food ProcessingEnterprises (PM-FME) Scheme, Indian Institute of Food Processing Technology, Ministry of Food Processing Industries, Government of India,2018).

Vegetables are quite nutritious and perishable meals which have very quick shelf lives. Preservation of those crucial meals has been practiced for a long term by using number of methods. Pickling is a traditional form to preserves food products via anaerobic fermentationor acidification with vinegar. ensuing that fermented products are being frequently eaten by maximum number in societies in the course of the world. Recently, many technology had beenevolved for vegetable pickling. The primary process used for pickling vegetables is based on the biological activity of microorganisms that produce metabolites that have the ability to inhibit the growth of many contaminating and unwanted microorganisms. Pickle products fall into two general classes

1. It is made by fermenting or pickling cucumbers that have been aged for several weeks, during which the fermenting bacteria produce acids that lower the pH and preserve the product. And
2. Fresh-packed, or quick-process pickles, are simply vegetables that are bottled, covered with vinegar and other seasonings, and heat-sterilized. The market for canned vegetable products is dominated by pickles, fermented pickles and non-fermented pickles. (Aljahani, 2020, p. 415).

Flat beans are one of the important seeds of the Fabaceae family. This plant is one of theimportant legumes that contain essential acids. It is one of the less used legume groups, but itsnutritional content can be used as an alternative to overcome the malnutrition problem of peoplein developing countries. This plant has many vernacular names based on its distribution inmany countries, such as butter beans, sieva beans, Madagascar beans, haricot de Lima beans, pois du Cap, pois souche, pois savon, feijao de lima, feijao favona, feijão espadinho (portugal), mfiwi, sibatse simaron, patani, zabache (Philipina), thua rachmat (Thailand), dau ngu (Vietnam), kacang mas, roay (Sunda), kara, kratok (Java), gribig (Madura), saru (Minahasa),merah bean (Pontianak), and koto arbila (Timor).Lima beans have good adaptability in the tropics, especially in low-fertile, high-humidity, dry climates and moist soils. The geographicaldistribution of lima beans is extended from regions with arid climates to regions with highhumidity. Lima bean is an annual to perennial vine that has a hood shape of standard flowers and twinning keels. Wild lima species exhibit uncertain climbing growth habits, with extended flowering periods and abundant fruit production. (Bria1, Suharyanto, Purnomo, 2019, p. 62). Lima flat beans are high in carbohydrates, protein and fiber, but low in fat. Seeds contain largeamounts of vitamins B1, B2, B3 and B6. Flat lima beans can be eaten whole or just as beans. Relatively, flat lima beans contain about 12.07% moisture, 20.62% protein, 0.90% fats, 62.83% carbohydrates, 5.71% crude fiber and 3.55% ash per 100g. (Olaleye, Oresanya, Oladimeji, Okeke, 2020, p. 455).

It is used as a source of protein and income generation for farmers. Its characteristic is remarkable resistance to water and high temperature (Souza et al., 2019, p. 1).

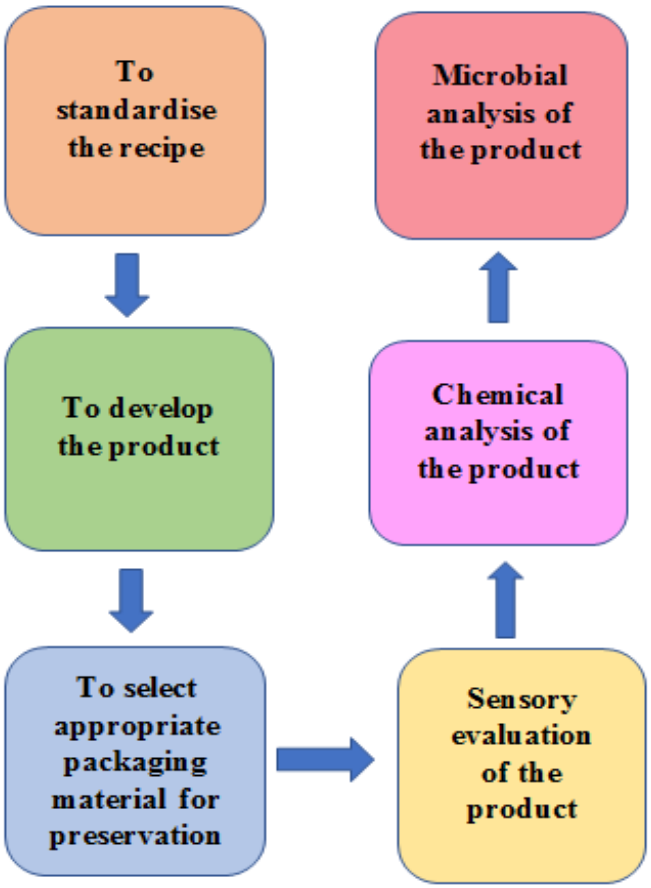
Spirulina has medicinal properties. These are used as medicine for fever, headache, ear infections, diabetes, wounds, abscesses, etc. However, despite its many uses and virtues, it hasbeen neglected. Spirulina is a multicellular filamentous cyanobacteria (blue-green microalgae) with symbiotic nitrogen-fixing bacteria. Its multicellular cylindrical trichomes are usually arranged along its length in an open left helix, and its surface is uncoated and smooth. It is a photosynthetic autotrophic plant with phycocyanin as the main photosynthetic pigment. Spirulina is an excellent source of iron, calcium and phosphorus, pigments (carotenoids, c-phycocyanin, chlorophyll-a) and vitamins (vitamin E, vitamin B12). It is also a rich source of digestible proteins (up to 70% of its protein content), polysaccharides and lipids and has a balanced aminoacid profile. It is also considered a good source

of essential fatty acids, including ω-6 linoleic and γ-linolenic fatty acids, as well as ω-3 fatty acids such as α-linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).This high nutritional value is thought to positively influence the treatment of several medical conditions such as certain cancers, hepatotoxicity, cardiovascular disease and hyperlipidemia, and among others disease. The Spirulina and Spirulina products market is expected to grow continuously and rapidly through 2028 with a Compound Annual Growth Rate (CAGR) of 18.1%.Most commercial microalgae products are produced in Asia or Australia, while European companies account for about 5% of the global microalgae market for food and feed.The demand for spirulina products is due to increasing health and vegetarian awareness, malnutrition, consumption of functional foods and demand for natural dyes. Currently, most ofthe production is directed towards food, dietary supplements and nutrition, which account for 75% of all reported uses. Spirulina supplements are classified into powder form, the most common form, as well as flakes, capsules, tablets, frozen spirulina and phycocyanin extract, and advertised as a healthy foods. Cultivation and marketing, such as methods of processing, packaging and transporting spirulina, can change its chemical composition, affecting its nutritional quality and toxicological properties. (Rutar et al., 2022, p. 1).

2. Material & Methods

The aim of this research was to develop nutritional and prebiotic rich flat lima beans pickles enriched by spirulina. Raw material was bought through market and through online sites. The acceptance of the product was judged by giving the product for sensory evaluation. The nutrient analysis of the product was done to know the value of proteins, fats, carbohydrates, moisture, titratable acidity, sodium chloride and ash content. The shelf life of the product was studied. The pickle was packed in the appropriate package material.

The steps in methods was divided in five parts:



2.1. Standardisation and development of flat lima beans pickles, enriched with spirulina.

Step 1: Peel the flat lima beans from side and add in water for boiling and add salt, according to taste.

Step 2: Rinse the water with help of the strainer and put it in the sun till it dries.

Step 3: Add Mustard oil and mustard powder to flat lima beans.

Step 4: Add spirulina powder, coriander powder, mustard seeds, crushed green chillies, turmeric powder, and salt according to taste, followed by addition of 1-2 tsp of vinegar.

Step 5: Mix it well till each and every piece of flat lima beans is covered with all the spices powder and vinegar. Step 6: Transfer it into a close air tight container/jar and keep it in the sun for 1- 2 hours.

After development of product, it was given for sensory evaluation among the consumers, total 40 consumers were selected, and the score was given. Score was given on appearance, taste, colour, aroma, texture and overall acceptability. For score, score card was distributed using 5 point hedonic scale. Sensory evaluation of the product is important because it gives us the idea about the food acceptability as it depends upon the consumer judgement using their senses. Sensory Evaluation is a method which is used to analyse and interpret the reactions of the food product as food choice is done on the basis of how appealing the food and its sensory characteristic is and thus sensory evaluation becomes important. Later chemical analysis was done to know the presence of various nutrient and their quantity. The process used to analyse were government approved. Later to study the shelf life of the product microbial analysis was carried out using VRBA, GYEA and SA agar to detect coliform, bacteria and yeast count respectively in the product. By checking the microbial load in the food product it helps us to know the safety of consuming the food product, it also helps to know whether the microorganisms are pathogenic by checking it's characteristics. If the shelf life of the product is known it helps us to use the product in that particular period and helps us to avoid the wastage of the product.

2.2. Food packaging

Food packaging is one of the most important processes in the food industry that helps maintain the quality of food products during storage, transportation and distribution. It is mainly done to protect food products from external influences such as biological, chemical ormechanical damage; contain and preserve food in a packaged state to avoid loss of quality, attract consumers, and provide product and nutritional information. For many years, ancient people consumed fresh food that they could gather from the natural environment without storing food. As the nomadic culture developed, so did the need for food containers. It took more than 300 years for food packaging to finally develop into what it is today. There are many packaging materials used since then. There are three main functions of packaging: Protect, Preserve, Promote. (Sarkar, Kuna, 2020, p. 29).

Product features should be considered as this is an important factor while choosing a product. Characteristics can be the shape, size and colour of the product. Packaging materials play an important role in determining the shelf life of a food product. Choosing the right packaging materials and technology is very important, helping to maintain product quality during distribution and storage. Packaging materials commonly used in food packaging include paper, cardboard, glass, metal, and plastic. (Sarkar, Kuna, 2020, p. 29).

The packaging material chosen for flat lima bean pickles is glass. Glass flask produced by heating a mixture of sand (73%) consisting of silica (99% SiO_2) as the main ingredient, broken glass or "cullet" (15-30% of total weight), carbonate of soda /sodium carbonate (Na_2CO_3) and limestone/calcium carbonate ($CaCO_3$ or $CaCO_3.MgCO_3$) and alumina (stabilizer) at 1350-1600˚C until the material melts into a solid liquid. (Sarkar, Kuna, 2020, p.29).

2.3. Advantages of glass jars:

- They are impervious to water, gases, odours, vapours and microorganisms and thusmaintain product freshness for a long time without affecting taste, flavour or safety.
- They are inert and do not react with packaged foods or migrate into food products.
- They are resistant to high processing temperatures making them suitable for heat sterilization or heat treatment when sealing.
- They are obvious to microwaves. They are transparent to display content allowing consumers to see the product.
- They can be moulded into a variety of shapes and colours. Variants in glass colour can protect light-sensitive content.
- They have the same filling speed as cans.
- They are rigid, have good insulation and have good vertical bearing capacity to allowstacking without damaging the container.
- They are reusable, hermetic and recyclable. (Sarkar, Kuna, 2020, p. 29).

Hence this was the purpose to select the packaging material as the glass material to preserve the product, for further protection natural preservative mustard oil was alsoadded, this ensures that product is safe.

3. Results and Discussions

After the development of flat lima beans pickles, its sensory evaluation was done, followed by chemical analysis and microbial analysis.

3.1. Sensory Evaluation

Overall acceptability of the product was given was 4.2, using 5 point hedonic scale. Sensory evaluation was done on the basis of following attributes- Appearance, Aroma, Taste, Colour, Texture and overall acceptability.

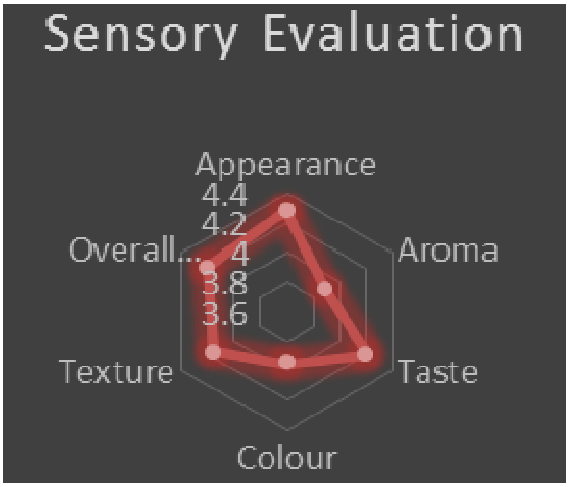


Figure No. 1 Sensory Evaluation

3.2. Chemical Analysis

Nutrients	Nutrient contents
Fat	7.18 g
Protein	12 g
Carbohydrate	10.165 g
Ash	2.08 %
Moisture	68.57 %
Titratable Acidity	0.11 %
Sodium Chloride	0.1 %

Table 1: Chemical Analysis

Chemical analysis was done to know the nutrient content of the product, they are listed in above table no. 1

3.3. Microbial Analysis

Microbial analysis was conducted to know the shelf life of the product for 30 days, therefore microbial analysis was done on day 7, 14, 21 and 30 as listed in below table no. 2. VRBA i.e. Violet Red Bile Agar is used to detect *Coliform* microorganisms, GYEA i.e. Glucose Yeast Extract Agar is to detect aerobic bacteria and SA i.e. Sabouraud agar to detect presence of yeast.

4. Conclusion/Summary

Flat Lima beans pickle was developed and was enriched with spirulina. Glass jar was selected as a packaging material for the product. The product didn't had any added preservative or colorants. Acceptability of the product was checked by carrying sensory evaluation amongst the consumer using 5point hedonic scale. Nutrient analysis of the product was carried out. For 5g sample 5x 10^5 is acceptable count for aerobic plate count, but it is danger if the count reaches to 5 x 10^6. Shelf life of the product was carried out, till day 21^{st} product can be consumed, at 30^{th} day product can be consumed but gave off flavour showing the sign that soon product will deteriorate. The shelf life of the product can be increased if proper packaging technique is used and more precaution is taken while preparing the product.

DAYS	VRBA	GYEA	SA
7^{th} day	0.0 cfu/ml	2.5 x 10^5	0.0 cfu/ml
14^{th} day	0.0 cfu/ml	2.6 x 10^5	0.0 cfu/ml
21^{st} day	0.0 cfu/ml	2.9 x 10^5	0.0 cfu/ml
30^{th} day	0.0 cfu/ml	3.1 x 10^5	0.0 cfu/ml

Table 2: Microbial Analysis

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